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PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY

EREP INVESTIGATION #510

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Monthly Plans and Progress Report

PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY

OVERALL STATUS

Natural Vegetation Analog Study

Using a VP-8 electronic image analyzer, the 426 analog sites in the Colorado Plateau test area that were reported on last month were measured for relative transmittance values as imaged on one 9" x 9" color infrared transparency (S190A). Table I shows mean relative transmittance values for each analog investigated.

Broad vegetation-environmental units show the following transmittance characteristics of analogous legend units on the Skylab II S190A transparency: salt desert vegetation (324) - 791.8 ± 313.3[1/]; riparian cottonwood-willow communities (342.6) - 444.6 ± 81.7; shrub steppe/pinyon-juniper zone (325.5, 425.5 and 341.3) - 642.1 ± 168.0; and montane forests (340) - 400.6 ± 69.9.

The four vegetation analogs (324.6, 324.7, 325.5, and 351.3) with highly variable transmittance characteristics on the color infrared transparency were also poorly differentiated by interpreters on the color infrared prints (50.0, 56.5, 50.0 and 28.0% correctly identified, respectively). On none of these sites does vegetative cover exceed 40% and in most cases it is much less than 40%. (Ten sample plots of each of these analog types were analyzed for cover values of wood vegetation on large-scale, EarthSat-flown

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[1/] Indications of variability presented throughout this report are one standard deviation around the mean.

Table I

RELATIVE TRANSMITTANCE VALUES OF SELECTED VEGETATION-ENVIRONMENTAL ANALOGS FROM SKYLAB II, 190A, CIR IMAGERY OF THE COLORADO PLATEAU

Legend Symbol	Analog	N	Mean	Standard Deviation
210	Lakes and Reservoirs	5	479.4	± 44.3
280	Snow	5	1246.8	± 35.3
312.3	Semidesert Annual Communities	10	520.2	± 93.6
315.4	Sedge (Carex) Communities	10	401.7	± 96.1
324.6	Greasewood (Sarcobatus) Communities	10	722.7	± 213.7
324.7	Saltbush (Atriplex) Communities	12	1132.6	± 213.3
325.5	Shrub Steppe (Artemisia) Communities	15	659.2	± 110.5
341.3	Pinyon-juniper Communities with 10 to 40% Cover	10	708.3	± 181.0
341.3	Pinyon-juniper Communities with 40 to 70% Cover	11	448.5	± 71.0
341.6	Pine Forest Communities	16	398.7	± 77.7
342.6	Riparian Cottonwood-Willow (Populus-Salix) Communities	11	444.6	± 81.7
342.7	Oak Woodland Communities	12	429.0	± 63.7
342.8	Aspen Communities	11	369.6	± 36.9
343.7	Aspen/Spruce-fir Forest Communities	10	395.8	± 46.5
425.5	Cultural Shrub Steppe Communities	10	812.8	± 92.8
900	Obscured Land (Clouds)	5	1159.0	± 239.6
	$\Sigma N =$	163		

70mm color infrared photography. Values were 6.8% for 324.6, 12.3% for 324.7, 18.9% for 325.5, and 22.1% for 341.3.)

Table II shows the variability within stands. Ten measurements were made within each stand. Stand size is approximately 80 acres.

Table II

RELATIVE TRANSMITTANCE OF SELECTED ANALOGS FROM SKYLAB II 190A IMAGERY

Stand Number	Analog	N	A) .6-.7 μ	B) .8-.9 μ	B-A	$\frac{B-A}{B+A}$
427	341.3	10	200.6 ± 11.4	279.0 ± 10.7	78.4 ± 20.1	.164 ± .044
386	341.3	10	168.5 ± 15.8	309.9 ± 38.4	141.3 ± 41.9	.293 ± .066
242	341.3	10	248.6 ± 31.2	287.0 ± 60.7	77.6 ± 47.2	.134 ± .084
681	341.3	10	297.1 ± 19.0	317.6 ± 26.2	28.6 ± 14.5	.046 ± .024
394	341.3	10	213.2 ± 20.2	286.4 ± 37.6	74.9 ± 35.0	.147 ± .062
140	341.6	10	720.6 ± 28.9	365.2 ± 47.8	-371.2 ± 41.8	-.348 ± .059
82	341.6	10	650.8 ± 124.1	244.0 ± 27.3	-445.3 ± 83.6	-.458 ± .067
361	341.6	10	757.9 ± 57.3	246.3 ± 37.8	-482.8 ± 76.3	-.470 ± .070
		ΣN = 80				

An analysis of variability between these two analogs gives the following results:

Analog	A) .6-.7 μ	B) .8-.9 μ	B - A	$\frac{B-A}{B+A}$
341.3	223.6 ± 48.1	296.4 ± 39.5	81.4 ± 48.6	.1579 ± .099
341.6	719.3 ± 65.9	278.4 ± 65.5	-437.2 ± 81.5	-.4317 ± .082

From these results it can be seen that transmittance values for both analogs are very similar in the infrared region (.8-.9 micrometers) while

transmittance values are significantly different in the visible wavelength (0.6 to 0.7 micrometers). Various methods accentuating the differences in transmittance values confirm this observation.

All of the other analog types rarely have cover values below 75%. It is significant that on color infrared imagery only those sites with less than 25% cover were poorly identified by photo interpreters while all types with $\geq$ 75% vegetative cover were identified by the same interpreters with much greater accuracy (63.8% to 95.5%).

When the four semidesert vegetation complexes (324.6, 324.7, 325.5 and 341.3 with 10 to 40% cover) are treated as one unit, it is seen that the combined types are rarely misinterpreted as any other vegetation analog. The percentage correctly identified by interpreters equals 90.1. Accuracy drops slightly when tertiary level legend units are identified within this broad vegetation complex. When all salt desert vegetation as a group (324), shrub steppe and sparse (10 to 40% cover) pinyon-juniper woodlands (325.5 and 341.3) as a group, and dense pinyon-juniper woodlands with 40 to 70% cover (341.3) are identified, interpretation success dropped to 75.9%, 85.2% and 75.0%, respectively. The 341.3 analog, with sparse overstory cover could validly be mapped as a sub-unit of the shrub steppe complex without serious practical consequences. Many species common to the shrub steppe mosaic (e.g., <u>Artemisia</u> <u>arbuscula</u> and Poa spp.) are also of considerable importance in the more xeric end of the pinyon-juniper environmental gradient. At this position on the landscape many small inclusions of big sagebrush (<u>Artemisia</u> <u>tridentata</u>) make the sagebrush communities and sparsely covered pinyon-juniper understory communities very similar in vegetational composition. It is not surprising that transmittance values and variabilities are also similar.

A preliminary analysis of Skylab II 190A black-and-white photographic products was made of selected analogs in the Colorado Plateau test site. Relative transmittance values of 341.3 (cover 10 to 40%) and 341.6 analogs were measured with a VP-8 electronic image analyzer. The 9 x 9 inch negative transparencies of Pan-X black-and-white film (0.6 to 0.7 micrometers) and infrared black-and-white film (0.8 to 0.9 micrometers) were used in the analysis.

AUTHOR IDENTIFIED SIGNIFICANT RESULTS

Below approximately 25% cover visual photo interpretation of vegetation analogs of Skylab II S190A color infrared imagery is poor. Correct identifications of vegetation analogs in this category range from 28 to 57%. Good photo interpretation results (64 to 96%) were obtained on vegetation analogs with higher cover values.

The four semidesert vegetation analogs (greasewood--324.6, saltbush types--324.7, big sagebrush types--325.5, and pinyon-juniper types with < 22% cover--341.3) are consistently distinguishable as a group. Photo interpretation accuracy equals 90.1%. When these same types are broken into two sub-groups (salt desert vegetation and shrub steppe/sparse pinyon-juniper vegetation) interpretation success drops to 76% and 85%, respectively.

Band ratioing and transmittance differences between two forested analogs as imaged on Skylab II S190A film in cameras 2 (0.8 to 0.9 micrometers) and 5 (0.6 to 0.7 micrometers) show significant differences. In the infrared wavelength both analogs have very similar transmittance characteristics while the visible wavelength shows separation between the two. Relative transmittance values for stands of ponderosa pine

forestland and pinyon-juniper woodland are 719.3 $\pm$ 65.9 and 223.6 $\pm$ 48.1, respectively on negative transparencies from camera 5. In image interpretation along the low-elevation fringe of forested regions these are the two forest analogs most frequently requiring separation.

Rice Analog Studies

Skylab III (SL3) imagery has yet to be received of the Northern Great Valley test site, and analysis continues of the single date of photography available. Progress has been made in three major areas: (1) collection of additional ground data, (2) identification of rice signatures on multiband imagery, and (3) determination of rice crop acreage.

Due to poor initial farmer response to our requests for cooperation in the Maxwell subsample area, it was considered a contingency area. However, the SL2 ground track included the Maxwell area and excluded one area where farmer cooperation was excellent. To bring the Maxwell area up to approrpiate ground data level, two farmers with extensive holdings were again contacted and persuaded to participate in the programs. These farmers have promised needed ground data for an area in excess of 2,500 acres. This will be a sufficient area for our sample size and design. Ground data from the remaining three subsample units is continuing to arrive.

A perusal of the field data sheets indicates that the rice crop was excellent this season, with few yield limiting problems and an overall higher than normal yield. Due to the relatively low incidence of problems in California, an attempt will be made to integrate the ground data collected in Louisiana in the multistage prediction procedures.

It is hoped that yield limiting factors act in a general fashion and that parallels can be drawn between the Louisiana rice crops and California's, regardless of the specific yield limiting factor or agent.

The early June date of acquisition is not optimal for identifying rice fields or evaluating condition of the crop. This early in the season, a majority of the rice fields have just been planted or are just emerging from the flooded fields. Consequently, the primary image determining feature is the body of water rather than rice plant biomass. In crop discrimination, crop phenology is of central importance; therefore, it is vital to determine characteristic image features for each stage of field or crop condition. The flooded stage is an extremely important stage because of its exclusive use in rice culture. Analysis procedures are being performed to define discrimination characteristics on the SL2 imagery available from this phenological stage.

To date microdensity readings have been completed for the four black-and-white bands from one of the three test sites. The ins-rument used was a VP-8 Image Analyzer (Interpretation Systems Inc.) with S190A 9 x 9 inch positive transparency images. We chose an area with only four major crop/cover categories for this test. The results from each band are shown in Table III. These results indicate that the within group variability for each separate band is often greater than between group difference for some categories. These results, for even this relatively simple, four category sample, indicate difficulty in discriminating rice on <u>single date</u>, <u>single band</u> imagery.

Definitive progress is being made in the quantitative mapping of rice acreage on the SL2 imagery. Due to the small scale of the Skylab

Table III

RESULTS OF MICRODENSITY READINGS TAKEN FROM FOUR BANDS OF SKYLAB II 9 x 9 INCH IMAGERY

Machine used was an Interpretation Systems Inc. VP-8 Image Analyzer.
The values in the table are unstandardized relative density measurements.

Band	Crop	Field Sampled	Measurements	Range Low	Range High	Mean ($\bar{x}$)	Standard Density (6)
06	Rice	7	35	546	933	710.9	118.95
0.5 - 0.6 μ	Stubble	4	20	1033	1248	1110.5	73.14
Pan X	Fallow	1	5	1203	1267	1244.6	25.60
	Bare ground	4	20	625	925	780.2	110.83
05	Rice	7	35	36	279	102.9	56.36
0.6 - 0.7 μ	Stubble	4	20	485	929	672.8	123.10
Pan X	Fallow	1	5	766	669	738.6	39.39
	Bare ground	4	20	100	325	204.2	79.05
01	Rice	7	35	192	608	366.6	112.68
0.7 - 0.8 μ	Stubble	4	20	490	939	607.1	111.60
B&W IR	Fallow	1	5	560	678	625.2	57.68
	Bare ground	4	20	180	263	231.0	29.30
02	Rice	7	35	50	212	119.5	39.12
0.8 - 0.9 μ	Stubble	4	20	258	458	333.8	65.74
B&W IR	Fallow	1	5	310	358	326.6	18.50
	Bare ground	4	20	71	128	106.4	16.35

imagery ditches, field borders, and other nonproducing areas within the field boundary could not be accurately separated. To solve this problem we defined a factor to adjust total field acreage to cropped acreage. An average acreage reduction factor of 0.1303 was determined by using 1:30,000 large scale aircraft support photography of the Northern California agricultural areas.

TRAVEL PLANS

No travel is planned to either natural vegetation study area or the agricultural test site.

PERSONNEL

Since the last reporting period, Bill Myers has joined the staff and has been involved in analyses.

PROBLEMS

No significant problems are evident since the last reporting period.

PLANS FOR NEXT REPORTING PERIOD

Multispectral reflectance characteristics of selected analogs will be compared interregionally using electronic image analysis equipment. Although cloud cover eliminates any chance of mapping Skylab II image products in the Sierra-Lahontan test site, enough clear area exists to make analyses of a few interregional analog types. Their spectral characteristics and variability will be documented on Skylab II 190A imagery. These results will be analyzed and used to conduct density slicing experiments in the Colorado Plateau test site. Mechanical

techniques will be used to map a selected area of Southwestern Colorado and the results compared with existing resource maps.

Similar procedures along with visual interpretation will be conducted on Skylab III imagery once this data is received by us. This will allow phenological development to be documented.

Interpretation is proceeding on: single band analysis in more complex areas, (2) additive color composites using black-and-white multiband imagery, and (3) multiemulsion layer imagery (Skylab generated color and color infrared frames).

Once criteria for identifying rice fields have been firmly established, it will be possible to simply outline the fields or blocks of fields, determine the area of these delineated portions and apply the acreage reduction factor (0.1303) to determine the production acreages. It must be emphasized that this crop acreage adjustment factor is valid only in California under very similar cultural practices.